DATABASE MANAGEMENT SYSTEMS
(CSE3101)

Time Allotted : 2½ hrs **Full Marks : 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i) In ER diagrams, which of the following describes the concept of generalization?
(a) A process of defining a more specific entity.
(b) A process of defining a more general entity from specific entities.
(c) A relationship between weak entities.
(d) A relationship between strong entities.

(ii) Which of the following is a characteristic of a weak entity?
(a) It has its own primary key (b) It depends on a strong entity
(c) It is independent of other entities (d) It can have multiple primary keys.

(iii) The ability to change the conceptual schema without affecting the external schemas or application programs is known as _____.
(a) Program data independence (b) Logical data independence
(c) Physical data independence (d) Data abstraction

(iv) In relational algebra, the operation that combines tuples from two relations using condition based on common attributes is called:
(a) Union (b) Intersection (c) Projection (d) Join

(v) Which of the following SQL clauses is used to eliminate duplicates in a query result?
(a) DISTINCT (b) GROUP BY (c) HAVING (d) ORDER BY

(vi) If there are two relations R and S, with *n* and *m* number of tuples respectively, the nested-loop join requires _____ pairs of tuples to be scanned.
(a) n (b) m (c) n * m (d) log(n) * log(m)

(vii) In 2-phase locking protocol, which of the following locks are compatible?
(a) Read-lock(A) by T1 transaction and write-lock(A) by T2 transaction
(b) Write-lock(A) by T1 transaction and write-lock(A) by T2 transaction
(c) Write-lock(A) by T1 transaction and read-lock(A) by T2 transaction
(d) Read-lock(A) by T1 transaction and read-lock(A) by T2 transaction

(viii) What is the key difference between 3NF and BCNF?
(a) BCNF allows some transitive dependencies while 3NF does not
(b) In BCNF, every determinant is a superkey, while in 3NF, it's only required that non-prime attributes depend on the key
(c) 3NF eliminates all forms of redundancy, while BCNF does not
(d) 3NF allows some functional dependencies where determinants are not superkeys, while BCNF does not

(ix) If both the functional dependencies : X→Y and Y→ X hold for two attributes X and Y then the relationship between X and Y is
(a) Many to many (b) Many to one
(c) One to one (d) Many to one

(x) Which one is not a state of RDBMS transaction?
(a) Active (b) Passive (c) Partially Committed (d) Committed

Fill in the blanks with the correct word

(xi) The _____ join operator preserves unmatched rows of both of the relations that are being joined in a query.

(xii) MongoDB is an example of _____ database.

(xiii) In SQL, the _____ command is used to remove all records from a table without deleting the table itself.

(xiv) In SQL, _____ queries are those in which one query is embedded within another query

(xv) _____ clause in SQL, is used to specify a search condition involving group or aggregate function value in a query.

Group - B

2. Consider the following scenario:
A University database needs to store information about Students, Courses, and Professors.
- Each Student has a unique Roll_No, Name, and Date_of_Birth.
- Each Course has a unique Course_ID, Course_Name, and Credits.
- Each Professor has a unique Prof_ID, Name, and Department.
- A Professor can teach multiple Courses, but a course is taught by only one professor.
- A Student can register for multiple courses, and a course can have multiple students enrolled.

(i) Identify the entities, attributes (with keys), and relationships for the above scenario. *[(CO1)(Understand/LOCQ)]*

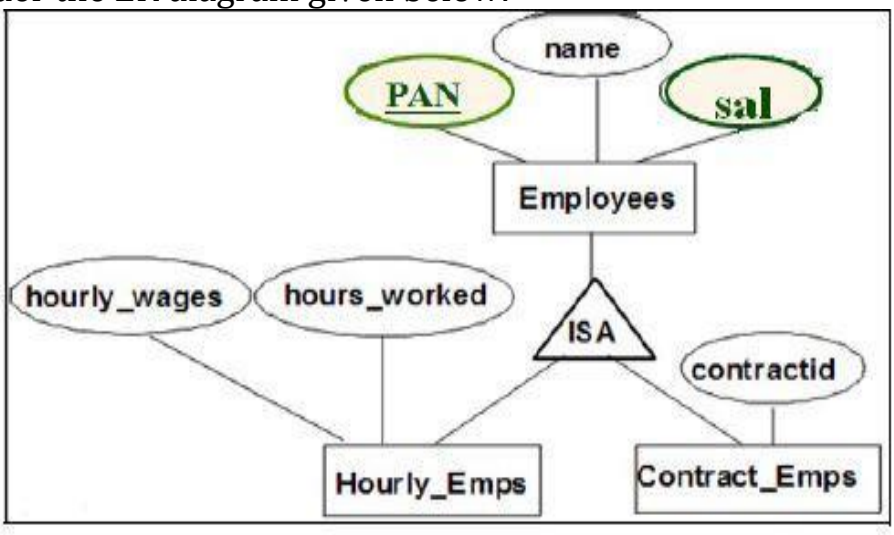
(ii) Draw an ER diagram for the above scenario, showing cardinalities and participation. *[(CO1)(Analyze and Design/IOCQ)]*

(iii) Convert the ER diagram into relational schema with appropriate Primary Key (PK) and Foreign Key (FK) constraints. *[(CO1)(CO3)(Analyze and Apply/IOCQ)]*

(4 + 4 + 4) = 12

3. (a) What is meant by mapping cardinality? Explain with appropriate examples.
[(CO1)(Understand/IOCQ)]

(b) Consider the ER diagram given below:



Clearly mention the relations (tables) you need corresponding to the above ER diagram. Mention the attributes and keys for each relation.
[(CO1)(CO3)(Analyze and Apply/HOCQ)]

5 + 4 + 3 = 12

Group - C

4. (a) Consider the relational database given below:
Residents(Rid, RName, Age) // Resident details
Vehicles(Vid, VModel, Colour) // Vehicle details
Reserves(Rid, Vid, Day) // Reservation of Vehicles
The underlined attributes are the primary keys. Day denotes the day of the week.
Write **Relational algebraic** expressions for i) and ii), and **SQL** for iii) and iv).
(i) Find the id and name of the residents whose age is less than 30.
(ii) Find the name of the residents who have reserved a blue coloured vehicle on Friday.
(iii) Find the models of vehicles which are most frequently booked.
(iv) Find the colour of vehicles which have not been reserved. *[(CO2)(Analyse/IOCQ)]*

(b) Draw an efficient query tree for ii). Justify your answer. *[(CO2)(Analyse/LOCQ)]*

[(2 × 2) + (3 + 3)] + 2 = 12

5. Consider the following relational database:
Suppliers(supplier_id, supplier_name, address)
Parts(part_id, part_name, color)
Catalog(supplier_id, part_id, cost)
Answer each of the following queries in **SQL.**
(i) Find the names of suppliers who supply some red colored parts.
(ii) Find the supplier_ids of suppliers who supply every part.
(iii) Find the part_ids of the most expensive parts supplied by suppliers named "Pipe Supplier". *[(CO3)(Apply/IOCQ)]*

(4 + 4 + 4) = 12

Group - D

6. (a) Consider the relation R(A,B,C,D,E,F,G,H,I,J) having the following set of functional dependencies:
AB → C, A →DE, B→F, F →GH, D→IJ
Determine the highest normal form of the relation R. Explain your answer. *[(CO4)(Understand/LOCQ)]*

(b) If R is not in 2NF, decompose R into 2NF, and then decompose into 3NF. If R is in 2NF, decompose R into 3NF. Show the steps. *[(CO4)(Apply/IOCQ)]*

(c) Is there a BCNF decomposition of R? Justify your answer. *[(CO4)(Evaluate/HOCQ)]*

4 + 6 + 2 = 12

7. (a) "Every candidate key is a super key". Justify with an example for or against the given statement. *[(CO4)(Analyse/HOCQ)]*

(b) What is a Primary key attribute? How does it differ from candidate keys? Provide examples. *[(CO4)(Learn/LOCQ)]*

(c) Find the attribute closures of AB for each of the following set of FDs:
(i) A→BC, AB→D, AC→D (ii) A→B, B→C, AB→C *[(CO4)(Apply/IOCQ)]*

4 + 4 + (2 + 2) = 12

Group - E

8. (a) Let T1 and T2 be transactions that operate on the same data items P, Q & R. Let r1(P) mean that T1 reads P, w1(P) means that T1 writes P, same for T2. Given are two schedules S1 & S2. Using precedence graphs, determine if they are conflict serializable or not. If S2 schedule is serializable, write down the equivalent serial schedule(s).
S1: r1(P); w1(P); r2(P); w2(P); r1(P); w1(P)
S2: r1(P); w1(P); r2(P); w2(P); r1(Q); w1(Q); r2(R); w2(R) *[(CO5)(Analyze/IOCQ)]*

(b) Describe the Two-phase locking protocol. Why is it required? Discuss its limitations. *[(CO5)(Understand/LOCQ)]*

(6 + 2) + (2 + 1 + 1) = 12

9. (a) What is the drawback of the B-tree index? How is it overcome using B+ tree index? *[(CO6)(Analyse/IOCQ)]*

(b) Describe briefly the different types of file organizations used for RDBMS. *[(CO6)(Understand/LOCQ)]*

(c) What do you understand by clustering indexing? Is it an example of sparse index or dense index? *[(CO6)(Understand/LOCQ)]*

(2 + 2) + 4 + (2 + 2) = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	27.08	59.38	13.54